

# Transformer Consultancy

## Designed to meet the needs of the modern electrical energy provider

GE's Kelman™ Transformer Technical Support (TTS) is a specialist group designed to help meet the needs of the modern electrical power sector. They provide the transformer technical expertise: a resource which is no longer available from a large number of companies in the energy supply business.

Transformer Technical Support provides specialist help for all owners of critical transformer assets and insights into issues that impact the operational reliability of primary / critical assets. They also provide technical advice on set-up for M&D Diagnostic online monitoring equipment to satisfy system strategies, they will advise on technical training that can be provided in all aspects of transformer operational life.

TTS employs transformer industry experts and apply a methodology developed by the late Dr Viktor Sokolov to carry out field testing, providing 'online' condition assessment of critical transformers. We continue this work in order to bring the most in depth knowledge possible on electrical transformers to our customers.

### Key Benefits

- Access to transformer specialists
- Assessment without the need for system outages
- Asset health diagnostic
- Root cause analysis of issues
- Operational recommendations
- Maintenance and/or repair advice
- Overload capabilities examined
- Remote fleet ranking

### Applications

- Medium and large sized transformers in energy supply systems
- Generation and transmission system assets
- Higher risk and/or consequence of failure
- Assets with known or suspected operational issues
- Heavy industrial customers



### In-Service Assessment

- Portable DGA oil analysis
- PD measurement electrical
- PD location acoustic
- Temperature profile
- Vibration tests
- Electromagnetic field measurement
- Cooling system measurements temperature and flow (ultra-sonic)
- Engineering design and maintenance reviews

### Fleet Ranking

- Identification of population
- Selected on site tests (DGA etc.)
- Historical and operational reviews
- Engineering external inspection

### Overload Evaluation

- Calculated options to assist strategic planning
- Ageing implications tabulated
- Management of forced system changes

### Failure Analysis

- Investigation of existing failure, cause and failure mode determination
- Valuable information to provide for a focused
- Customer strategy plan
- Assessment of impact on remaining population

### Design Review

- Reviews specification and actual operational life, thermal performance, insulation system
- Understanding historical design weakness

### Training

- Comprehensive look at transformer life
- Tailored to customer needs
- Focused on the specific units of assessments

### Consultancy with Manufacturers

- Design expertise at acceptance tests
- Specification reviewed to current standards
- Defect analysis and site investigation



## Today's Environment

In today's modern electrical power delivery sector networks are under more pressure than ever before. It is often the case that more is being demanded of ageing transformers, while maintenance resources and the essential local knowledge base are being reduced.

During the 1980's and 90's the energy supply industry and in particular the main transmission utilities decided to down size, most of the experienced transformer specialists' retired leaving a knowledge gap that has not been addressed. In house expertise was largely lost. Increasingly ageing assets will need more expert attention to predict remaining useful life.

## Our Experience

GE's Transformer Technical Support team offer customers an in-depth knowledge of transformer defect resolution. Our methodology enables the real-time condition of the critical assets to be determined by population, or as individual units. Specialist testing is carried out by transformer design and testing experts, as the transformers are in-service and operating at their normal operational conditions.

Our experts have been selected for their specific experience in asset management and transformer technical knowledge in the life management of these high value assets, maintenance and testing policy for these critical assets.

Over recent years we have carried out major projects to assist customers in their understanding of transformer operational condition and defects, with investigations in the Middle East, Asia Pacific, Europe, UK and South America. We also provide technical training seminars and workshops on all aspects of transformer life. We have provided these at our Lisburn site and also in customer's facilities in North America, Saudi Arabia and Malaysia.

We have experience in fleet ranking transformers, GSU transformers, thermal power stations and substations. In power plants we have found defective conditions that may affect short-term and long-term reliability, and provided solutions to sustain operational reliability.



# GE's Customer Technical Support

GE's customer technical support team can help your organization by providing the transformer knowledge that will help prevent premature failures, improve defect investigation and enhance best practice to secure operational reliability. GE can provide the solutions that are required for an ageing population of critical transformer assets.

## In-Service Condition Assessment

GE provides an in-service technical support offering which will tell you the true condition of critical assets "without outages", on-load data is the only way verify current condition.

The in-service condition assessment includes:

- An engineering design review
- Maintenance
- DGA oil analysis
- PD acoustic and electrical measurement
- Temperature profile (by design expert)
- Vibration tests (mechanical state)
- Electromagnetic field measurement
- Cooler system verification (ultra-sonic)
- Report recommendations
- Consideration is given to customer oil quality results (Lab analysis and their impact on the conclusions of the technical report)

## Failure Analysis

The team also investigates existing failure, cause and failure mode determination. This information is valuable and helps to provide for a focused, customer strategy plan. Additionally the team will write a failure report which will assess the impact on remaining transformer population. These investigations help improve the reliability of the remaining units and the impact on system reliability.

## Design Review

GE reviews the current specification and actual operational life of the transformer. Including the thermal performance, insulation system, build quality, factory testing parameters and witness acceptance test regime. The team will then be able to recommend changes.

## Fleet Ranking of Primary Transformers

This evaluation is carried out with a DGA condition based risk methodology, which enables prompt access to critical information.

The team applies our on-line techniques to the identified transformer population, conducting historical and operational reviews. They will also look into the most likely failure mode for design types, carry out an engineering inspection on site Dissolved Gas Analysis and a review of historical oil data analysis will also be conducted.

## Overload evaluation

The GE Customer Technical Support team can help you to consider available options to facilitate strategic plans, look into the management of forced system changes, calculate the effect of overload conditions and help you understand the ageing implications of your transformers.

## Design Review

- Specification reviewed to current standards
- Consultation with manufacturers
- Know your transformer factory testing regime
- Third party design expertise for acceptance tests

## Training

GE can provide a comprehensive look at all aspects of transformer life, with training tailored to customer needs, delivered by highly experienced Transformer Specialists.

We offer seminars during site assessment testing for:

- Understanding transformer life
- Design review as the first step of transformer life assessment
- Understanding transformers failure modes
- On-line monitoring
- Condition-based ranking using portable diagnostic equipment
- Bushing performance and reliability
- OLTC performance and reliability
- Transformer insulating fluid – what is it?
- Transformer oil as a powerful diagnostic tool
- DGA Identification of faults in transformer equipment
- Maintenance concepts technical and economic issues
- Overview of effective diagnostic methods
- Detection and identification of typical defects in transformer design



## Scientific Background

Our colleague Dr Victor Sokolov (decd) was an eminent world renowned transformer expert from Ukraine. He lent his many years of experience in the design, build and defect analysis of large transformer to the transformer community. He used this experience to chair transformer committees in Cigre and IEC. His experience was in great demand around the world and he presented many technical papers at Cigre IEC Doble and IEEE.

Our methodology is focused on classification of transformer population in terms its reliability and usability on the basis of design review, operation condition review and comprehensive oil analysis. This allows effective risk management and ranking of the transformer population in the shortest time.

The most appropriate life assessment should concentrate on factors which directly influence the life of the transformer. A relative comparison of the transformers is an alternative to remaining life determination, which involves many uncertain assumptions. Condition-based assessment and ranking is the proper solution to select weak members among the transformer population to satisfy strategic planning.

Mineral insulating oil contains over 70% of diagnostic information. Dielectric withstands strength of insulation integrity and is determined by dielectric strength of the oil. By-products affect the dielectric margin and significantly accelerate cellulose decomposition. In conjunction with expert testing regime and equipment to measure significant factors such as cooling systems and mechanical state.

We implemented this novel methodology previously described and the results provide expert analysis of the real time issues to promote enhanced operational reliability without the need to take critical assets out of service.

## Portable Laboratory

GE provides a specialist-driven "in service testing program" using our portable laboratory to find the true operational condition of critical transformer assets.

- TRANSPORT X™ (portable multi-gas DGA)
- Infra-red equipment survey (by design experts)
- Partial discharge acoustic and electrical
- Electromagnetic field measurement
- Vibration measurement
- Ultra-sonic cooler function tests (efficiency calculated back to factory tests)
- Comprehensive laboratory analysis (customer's lab results considered vital ageing factors)



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